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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/249,292	02/12/1999	TETSUO ONO	503.36911CX1	9771

20457 7590 07/31/2002

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EXAMINER

OLSEN, ALLAN W

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 07/31/2002

17

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/249,292

Applicant(s)

ONO ET AL.

Examiner

Allan W. Olsen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 May 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-7 and 24-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-7 and 24-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 6.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

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DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1 and 2 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites a limitation including the phrases a "high peak point" and a "low peak point". With reference to the graph in figure 4, it is noted that there are high and low peak points associated with each axis of the graph.

The phrase "a few MHz" in claim 2 is a relative term which renders the claim indefinite. The phrase "a few MHz" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Should a value of 15 MHz or 10 MHz or 8 MHz be considered as constituting "a few MHz"?

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 1, 4-7 and 24-29 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 5,352,324 issued to Gotoh et al (hereinafter, Gotoh).

The rejection in the previous Office action is maintained. The rejection, as previously set forth, is repeated below in italics. The following non-italicized remarks pertain the newly added limitation.

Gotoh teaches applying a bias with a frequency of 1 kHz or more (column 8, line 12).

The newly added limitation requires that the frequency of the applied bias be such that the distribution of ion energy in the plasma includes a high peak point and a low peak point. Applicant's figure 5 is a graph profiling the ion energy distributions that are obtained from the application of two different bias frequencies. When a high biasing frequency is applied (e.g. 100 kHz) the graph shows that there are many high energy ions and there are many low energy ions, that is, the distribution of ion energies is largely bimodal in character. As shown by Applicant's figure 4, when the bias frequency is changed from 100 kHz to 1 kHz, there is a redistribution of ion energies such that the bimodal distribution obtained from the 100 kHz bias *almost* disappears. However, the graph of the ion energy distribution that results from applying a bias frequency of 1 kHz includes the same two maxima that are present in the graph of the 100 kHz bias. Therefore, Applicant's figure 4 demonstrates that the 1 kHz frequency of Gotoh is sufficient to meet the newly added limitations by providing a saddle-shaped profile of the ion energy distribution. Furthermore, it is noted that Gotoh teaches using a bias frequency of 1 kHz or more. In fact, the 1 kHz bias frequency is not the typical frequency used by Gotoh. The 1 KHz bias frequency is set forth by Gotoh as an example to show that the method can produce satisfactory results even when such a

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low bias frequency is applied. Gotoh's method would typically use a frequency in the "or more" range of "1 kHz or more". Gotoh does not explicitly state what bias frequency is used. However, Gotoh does state that the apparatus used is the same as that used in the prior art (column 4, line 22-65). Otsobo (4,808,258), a prior art reference that is cited in Gotoh, discloses applying an RF bias power to the substrate with frequency in the range of 0.5-20 MHz.

Claim 1: *Gotoh teaches a method of etching a substrate. Gotoh's method includes applying an RF bias to the substrate support. The RF bias power supply is independent from the power supply that is used for generating the plasma. Gotoh method includes providing the RF biasing power intermittently or on-off modulating the RF bias power.*

These teachings are sufficient to meet each limitation of independent claim 1. There is one limitation of claim 1 that was not explicitly taught by Gotoh. As explained below, the examiner considers this limitation to be inherent in Gotoh's method.

Instant claim 1 requires that the peak to peak voltage of the modulated bias power be set to a level such that the etching rate that is obtained with a modulated bias power is equal to the etching rate that is obtained with the continuous application of a smaller peak-to-peak voltage bias power. The examiner contends that the application of a bias power increases the rate of etching and that the rate of etching modulates with the modulation of bias power. The bias-off periods correspond to periods with a lower etching rate. Therefore, simply modulating the bias power leads to an overall decrease in the rate of etching. On the other hand, increasing the peak-to-peak voltage of the bias power increases the rate of etching. Therefore, to maintain the same etch rate, as is required by claim 1, the reduction in etch rate, brought about by modulating the bias, must be compensated for by increasing the peak-to-peak voltage of the bias power.

Claim 4: *Figures 5 and 6 of Gotoh teach the use of a duty cycle (i.e. percentage of time that bias power is on) that corresponds to the 5 %-50 % of instant claim 4.*

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Claims 5-7: Gotoh's figure 9 shows the time line for a process that is divided into several steps (for example, just etching and over etching). Within the first half of the process, the bias power is modulated. During the first half of the process, the nitride to oxide selectivity is lower than it is during the second half of the process. See also column 10, line 59 – column 11, line 3.

Claims 24-28: Figures 4a and 7 and column 6, line 18 – column 9, line 41 of Gotoh address the limitation of claims 24-28. Gotoh's method is applied to anisotropically etch a 0.5 μm feature into a substrate. The method is described and shown to provide features with vertical sidewalls and flat bottoms. Gotoh teaches using a frequency for the on-off modulation of the bias power that is lower than the actual frequency of the RF power itself.

Claims 1, 2, 4 and 24-29 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. 6,093,332 issued to Winniczek et al (hereinafter, Winniczek).

The rejection in the previous Office action is maintained. The rejection, as previously set forth, is repeated below in italics. The following non-italicized remark pertain the newly added limitation.

With regard to the newly added limitation that requires a bias frequency be selected such that the claimed, saddle-shaped, ion energy distribution profile will be obtained, the examiner notes that Applicant indicates that this limitation is met when the selected bias frequency is from 100kHz to a few MHz. Winniczek teaches using a bias frequency of a few MHz, specifically, 4 MHz (column 4, line 39).

Claim 1: Winniczek teaches a method of etching a substrate that includes applying an on/off modulated RF bias power to the substrate support. The RF bias power supply is independent from the power supply that is used for generating the plasma.

Regarding the V_{pp} and etch rate limitation - the examiner is applying to this rejection the same reasoning that was used in the above rejection over Gotoh

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Claims 2 and 3: *The specific Vpp values that are claimed in claims 2 and 3 are not explicitly taught by Winniczek. However, Winniczek teaches applying a 4 MHz RF bias and modulating the power level from between 2500 W and 0 W with the frequency of the modulating set between 0.1 Hz and 1000 Hz. It is the examiner's position that the instantly claimed peak-to-peak voltage will be obtained when conducting the method of Winniczek within the range of these parameters. See column 8, lines 29-45.*

Claim 4: *Winniczek teaches a duty cycle of between about 10% and less than 100% (col. 8, lines 41-42).*

Claims 27 and 28: *Winniczek teaches a 4 MHz RF bias that is on/off modulated at a frequency between 0.1 Hz and 1000 Hz. Winniczek teaches that this method provides a selective anisotropic etching process (see column 7, line 53 – column 8, line 16).*

Response to Arguments

Applicant's arguments filed May 20, 2002 have been fully considered but they are not persuasive. Applicant's arguments were focused on their position that the applied references (Gotoh and Winniczek) do not teach the newly added limitation. As such the examiner's response to these arguments are presented in the above rejections.

Conclusion

All of the prior cited on the enclosed PTO form 892 has been cited by the applicant or the examiner in previous papers. With the exception of Geeckie, the references were cited by Applicant in an IDS (paper # 6, of which an initialed and signed copy is enclosed). They are included on the enclosed 892 so as to provide a more complete and customary recordation of the information contained therein. Geeckie is included as it is not apparent from our record that this reference had been previously listed on an 892.

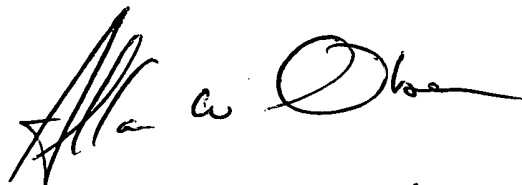
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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is (703) 306-9075. The examiner can normally be reached on Monday through Friday from 9:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski, can be reached on (703) 308-4333. The fax phone number for this Group is (703) 305-7719.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.
July 26, 2002


Examiner A.U. 1763